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ABSTRACT

The study is concerned with auditory versus visual presentation of several kinds of verbal materials: (1) word pairs; (2) sentences; and (3) prose passages. Ninety-six fourth and sixth graders from a predominantly white, middle class suburban area served as subjects. Major hypotheses included: (1) a mode-by-materials interaction would exist such that the paired associated would be best learned visually, the prose passages best aurally, and the sentences equally well in both modes; (2) a grade-by-mode interaction would exist such that fourth graders would be superior in the auditory mode and sixth graders in the visual mode; and (3) an immediate measure of retention would favor the visual mode, while a delayed measure would favor the aural mode. Research design, materials and apparatus are all elaborated. The inconclusive results suggest a need for further study of the precise parameters of obtained modal differences. However, support is lent to the hypothesis that prose materials are best presented aurally and that complex relationships exist between the effects of mode and length of time and materials are remembered. (TL)

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CHILDREN'S VERBAL LEARNING AND COMPREHENSION IN THE AURAL AND VISUAL MODES[1]

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The present study is concerned with auditory vs. visual presentation of several kinds of verbal materials (word pairs, sentences and prose passages). They represent, on the one hand, some of the different kind of tasks found in the literature dealing with the learning and comprehension of verbal materials and, on the other hand, analogues of some of the verbal tasks encountered in the classroom learning situation. Young readers were employed as subjects in order to examine these issues in a population whose verbal processing skills were still developing and which has not been widely studied in this regard.

The modal question has remained shrouded in a mist of varying experimental procedures, subjects, materials, and sub-issues. While this circumstance is not unique to this area of verbal processing (Williams, 1970), it is not therefore any less unfortunate. Day and Beech's (1950) review of the literature noted the extreme difficulty of drawing any broad conclusions about the effect of mode because of the lack of comparability

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of subjects, methods and materials. More recently, Travers (1970) notes that "almost nothing could be found in more recent literature which followed up systematically the knowledge already gained from the studies reviewed by Day and Beach."

The materials for this experiment were chosen to represent points along a "continuum" of interrelatedness or organization, i.e., from relatively discrete and unrelated word-pairs to sentences and then prose passages. In light of the previous research (e.g., Day and Beach, 1950) it would be anticipated that as the materials became more organized or related, the relative effectiveness of aural presentation would increase. It was hypothesized that there would be a mode-by-materials "interaction" such that the paired-associated would be best learned visually, the prose passages best aurally, and the sentences equally well in both modes. Since the superiority of visual presentation has been seen as related to increasing age, fourth and sixth graders were selected for study as "young readers" (i.e., old enough to be able to read continuous discourse of some complexity, but young enough to show trends in the development of their verbal learning and comprehension skills). Thus it was also hypothesized that there would be a grade-by-mode interaction such that the fourth graders would be superior in the auditory mode and the sixth graders would be favored in the visual mode. Finally, in accord with the suggestion that delayed recall measures may favor the aural mode, it was hypothesized that an immediate measure of retention would favor the visual mode, while a delayed measure would favor the aural mode.

Method

Subjects

Ninety-six fourth and sixth grade students at an elementary school in the suburban Philadelphia area served as subjects. The school is situated in a middle-class, predominantly white area. School records were used to screen potential Ss for gross, uncorrected sensory defects and intellectual impairments.

Sixteen Ss were assigned to each cell, in a modified version of a stratified-sampling procedure by which a proportional number of students from each classroom was assigned to each of the three materials groups (paired-associate recall, sentence recall, and prose comprehension). Within this restriction and those imposed by the blocking paradigm, subjects were assigned randomly. Half of the Ss received each set of materials in one mode and half in the other mode. Half of the Ss began with one mode as the first condition and half with the other mode first. There was an equal number of males and females in each of these "halves" of each cell.

Materials

Paired associates.--Two lists of eight pairs each were constructed from concrete nouns listed as A or AA frequency words in the Thorndike-Lorge (1944) word list. Each list contained four three-letter pairs and four four-letter pairs. Assignment of words to pairs and of pairs to lists were random, with the constraint that no ordinarily occurring pairs (such as "toy-box") were created.

Sentences.--Two lists of six sentences each were constructed from those employed by Johnson (1965). The sentences were composed of A and AA

words. Each list contained twenty-seven words, and the assignment of sentences to lists was random.

Paragraphs.--Two sets of paragraphs and associated questions were selected from the Listening test of the Sequential Tests of Educational Progress Forms 4A and B, according to the following procedure. First, questions designated by the test manual as testing "comprehension" or simpler "implications of ideas" were identified. Secondly, questions were identified whose difficulty level for the fifth grade (the median grade level for the experimental sample) fell between 40 and 80 percent. Paragraphs for which there were two or more questions meeting both of these criteria were given preliminary consideration. Several of these paragraphs had to be eliminated, however, because they were too long to be presented in a single frame. Pairs of paragraphs and questions were then prepared by matching, as nearly as possible, the length and content of each paragraph and the median difficulty of its questions. Each member of a pair of paragraphs contained the same number of questions. One member of each pair of paragraphs and its questions was then randomly assigned to one of the sets of materials, and the remaining one to the other set. Each set contained five paragraphs, three with two questions each and two with three questions each. An additional question for each paragraph was selected in a similar way for the delayed-measure portion of the task.

Apparatus

The visual items were typed in a primer-face on Ektagraphic slides and presented by a Carousel slide projector on a rear projection screen. Timing was accomplished by coordinated tape signals to the projector. The

auditory items were tape-recorded and presented through a stethescope headset. The word-pairs were typed on Kodak Ektagraphic slides, and the remaining materials were photographed from typed or printed originals. In the multiple-choice response situation with the prose materials, a four-button response panel was added which momentarily displayed S's choice for E to record.

Procedure

Paired associates.--Each list was presented in the recall of study-test paradigm. There were ten such trials of eight word-pair and eight stimulus presentations at a 2.5-second rate. Each section of each trial occurred in a different random order. There was a 2.5-second interval between the "study" and "test" sections of each trial and a 10-second trial interval. An eleventh "test" section of a trial was used as the delayed recall portion of the task. S responded orally.

Sentences.--Each list of sentences was presented one at a time, followed by the complete subject of each sentence alone (e.g., "The tall boy"). The S was instructed to respond orally with the rest of the sentence as he remembered it when the subject was presented. There were five such trials, each with a different random order of sentences or subjects. A sixth presentation of the subjects alone constituted the delayed recall task. Each sentence's visual presentation time was determined by its oral reading time (2.5 to 3.5 sec.). There was a 2.5-second interval between the study and test portions of each trial and a 10-second intertrial interval.

Paragraphs.--Each paragraph was presented, followed by its comprehension questions. The presentation time for each paragraph was

determined by the oral reading times suggested in the test manual (50 to 95 sec.). Time for each question was its oral reading time plus ten seconds for response, as suggested in the test manual for questions of this type. No S failed to respond within this time limit. There was a 2.5-second interval between a paragraph and its questions and between each question. There was a 10-second interval between the last question of one paragraph and the presentation of a new passage. One additional question for each paragraph, presented in the same way, served as the delayed recall portion of the task.

Results

Since there were no significant differences between mean scores on Forms A and B in any of the materials groups, the results for the two forms are considered together in each case. Table 1 presents the means of the measures used in each of the three materials conditions.

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Insert Table 1 about here
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Paired associates.--An analysis of the number of correct responses to the paired associate task indicated that the task was performed equally well in each mode ($F < 1$, $df = 1/30$) and at each grade level ($F = 1.16$; $df = 1/30$). There was no grade-by-mode interaction ($F < 1$, $df = 1/30$). Separate analyses performed on the number of confusions (the supplying of the wrong response word) and omissions (failure to respond at all) reflected the similarity of performance in both modes and at both grade levels. An analysis of the number of correct responses in the delayed recall trial

indicated similar performance after the delay interval (Mode: F <1, df = 1/30; Grade level: F = 1.39, df = 1/30; Interaction: F = 2.51, df = 1/30).

Sentences.--Comparisons were made of the mean number of words correctly given in response to the presentation of the complete subject alone for each grade level and each mode. For the immediate measure, there were no significant differences between modes or grade levels (all Fs <1, df = 1/30). A separate analysis performed on the delayed recall trial yielded similar findings.

Paragraphs.--An analysis of the number of correct responses to immediate recall of the paragraph comprehension questions revealed that there were no significant differences between modes or between grades (Mode: F = 1.36, df = 1/30; Grade: F = 1.42, df = 1/30; Interaction: F = 1.2, df = 1/30). However, a similar analysis performed on the comprehension questions asked after the delay interval showed that the auditory presentation mode was significantly superior to the visual presentation mode (Mode: F = 7.81, df = 1/30; p <.01; Grade: F <1, df = 1/30; Interaction: F <1, df = 1/30).

Discussion

The findings reflect the variety of previous findings in the comparison of modes of presentation. In two of the three materials groups, children in both age groups and working in both modes perform about equally well. These findings accord with several studies, especially that of Schultz, which have carefully equated the manner of presentation in each mode. While the materials and tasks were designed to be of appropriate difficulty for typical fourth and sixth graders, they may have been somewhat easier for the present suburban sample than for the typical child. Additional research involving several levels of task difficulty (i.e., speed of presentation, list length, difficulty of sentence structure, etc.) is clearly in order to investigate difficulty (within a single study) as a possible source of differing results in modal comparison studies taken as a whole. It would be hypothesized that for easier tasks, performance would be similar on the two modes, with task materials "interactions" appearing as difficulty increased.

The finding of a significant difference in favor of the aural mode in the delayed retention measure for prose passage comprehension gives some confirmation to the hypothesis that materials would "interact" with mode. The advantage shown for the aural mode was seen only in the prose passage condition, in accord with the prediction that an advantage would be demonstrated in the auditory presentation of these materials.

The apparent interaction of mode with delay interval in the prose passage condition is also in line with the prediction that delayed measures would tend to favor the auditory mode. The reason for this finding may

involve temporal organizational differences in long- and short-term memory (Broadbent, 1958), an issue not considered in the present study. Alternatively, it may be that this finding bears upon the hypothesized interaction of modal differences with task difficulty. That is, the delayed comprehension task may be simply more difficult (because of the passage of time and the interpolated materials) and thus favors the auditory mode. A study separating task difficulty from other variables, as mentioned above, would provide a clearer test of this hypothesis.

These results suggest the need for further study of the precise parameters of obtained modal differences. They also lend support to the hypothesis that prose materials may be better presented as auditory stimuli and that there may be important and complex relationships between the effects of mode and length of time that the materials are retained in memory.

TABLE 1

MEAN NUMBER OF CORRECT RESPONSES FOR EACH MATERIALS CONDITION

	Fourth Grade		Sixth Grade	
Paired Associates	Aural	Visual	Aural	Visual
Immediate Recall	42.56	40.31	45.87	48.18
Delayed Recall	5.62	4.37	5.62	5.81
Sentences				
Immediate	98.12	101.94	97.50	102.12
Delayed	24.44	24.75	25.56	25.44
Paragraphs				
Immediate	8.19	8.25	8.56	9.44
Delayed	4.50	3.94	4.43	3.69

Experiment II

The absence of modal effects in two of the conditions in Experiment I stimulated consideration of the notion that differences in the nature of the two sensory systems might be less important than variables associated with the two modes of presentation. The fact that the visual stimulus is spatial as well as temporal, while the auditory stimulus is only temporal, has often been noted (e.g., Henneman & Long, 1952; Travers, 1970). These observations suggest that some of the effects of mode may be due to the "availability" of the visual stimulus. Webb & Wallon (1956) addressed a similar issue by presenting stories to flight trainees by four methods: reading, listening, reading and listening simultaneously, and reading then studying. The last two methods proved superior to the first two. Day & Beach (1950) have also suggested that the greater "referability" of the visual stimulus may account for its superiority.

According to this line of reasoning, all comparisons of auditory and visual presentation confound mode of presentation with the availability of the stimuli, even when presentation times in the two modes are equated. Elimination of the spatial characteristic of visual presentation in the present case would result in the absurd task requirement of asking the subject to read by identifying successive portions of letters presented as they would appear in a one-to-one temporal relationship with spoken words. An approximation of comparing the modal and "availability" variables without confounding was devised for the prose comprehension condition of Experiment I. This comparison sought to retain the general conditions of presentation familiar to the subjects in order to avoid introducing the confounding of differential extra-experimental practice.

Experiment II was designed to assess the effect of "availability" in the context of the prose comprehension condition of Experiment I. Three points along a continuum of "availability" were defined by presentation of the paragraph task by (1) tape-recording, (2) slide projection (as in the auditory and visual presentations in Experiment I); and (3) in booklet form. These conditions are ordered from the least temporally "available" (tape) to the most "available" (booklet). It was hypothesized that, because of differences in "availability" of the stimulus, performance would be best in the booklet condition, intermediate in the slide condition and poorest in the tape condition.

Method

Subjects

Seventy third-grade students in the same school served as subjects. An equal number of boys and girls from each of the three third-grade classes were randomly assigned to each of the three conditions.

Materials

The paragraphs and questions described in Experiment I were augmented by the addition of a booklet version. Each booklet page contained one passage and its questions. In each presentation method the two sets of materials (Form A & B) were combined in a single form.

Apparatus

The apparatus employed in the main study was adapted for group presentation by the addition of three speakers to the tape recorder and by the use of a standard projection screen.

Procedure

With slight modifications, the procedures in Experiment I were followed. Subjects in the booklet condition were permitted the same amount of time to complete the task as the presentation time for the other two conditions (33.2 min.). In addition, the time to complete the task was noted for those subjects who finished early.

Results

The total number of correct responses to the paragraph comprehension items were subjected to one-way analysis of variance. The analysis indicated that the "availability" dimension was a significant source of variation ($F = 5.16$, $df = 2/68$, $P < .01$). A comparison of differences among means for the treatment groups using the Tukey HSD Test revealed that the mean of the visual (slides) group was significantly lower than that of either of the other two conditions. The remaining conditions did not differ among themselves (see Table 2).

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TABLE 2

EXPERIMENT II: DIFFERENCES AMONG MEANS OF NUMBER OF CORRECT RESPONSES (TUKEY'S HSD)

	(1)	(2)	(3)
(1) Aural (tape recording) $\bar{X}$ = 17.16 (n = 24)	-	4.77**	1.50
(2) Visual (slides) $\bar{X}$ = 12.69 (n = 23)		-	2.97*
(3) Booklet (w/limit) $\bar{X}$ = 15.66 (n = 24)			-

**p <.01

*p <.05

Discussion

The results indicate that the dimension designated as "availability" was a significant source of variation. This finding confirms the hypothesis that methods of presentation would differ. The specific comparisons follow the results of the first experiment in that the auditory presentation mode was superior to the visual (slides) mode in this prose passage comprehension situation. Other comparisons, however, indicate that this difference may be due to factors other than the sensory mode of reception. The scores on the comprehension items do not seem to be related to the amount of reference to the stimulus that the subject can can make. Rather, it may be that the auditory and booklet conditions were superior to the visual (slides) condition because this latter condition represented a marked departure from the typical method of receiving verbal information visually (i.e., the visual presentations were temporally constrained). While the auditory presentation is also constrained, it is typical of such presentations as they occur in everyday experience. This raises the question of the role of modal practice (the amount of prior experience the subject has had with verbal materials of a given type received in given mode). This concern has been raised in earlier studies (Henneman & Long, 1952) but apparently has not been directly addressed. A subsequent experiment, assessing individual learning curves over a longer series of trials, might be useful in studying the role of modal practice.

A second issue is raised in a joint consideration of the results of the two studies. In one case (Experiment II), the immediate recall measures on the passage comprehension test differed as a function of mode;

Discussion

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A second issue is raised in a joint consideration of the results of the two studies. In one case (Experiment II), the immediate recall measures on the passage comprehension test differed as a function of mode;

in the other case (Experiment I), they did not. Unfortunately, because of practical constraints, grade level (and consequently task difficulty) and group vs. individual administration of the tests are confounded in the present study. These results raise however the possibility of a mode interaction with group vs. individual administration. It may be that there are attentional differences in the group vs. individual situation that may render the auditory mode more effective with groups. A study in which subjects were randomly assigned to each condition of administration would clarify this issue.